

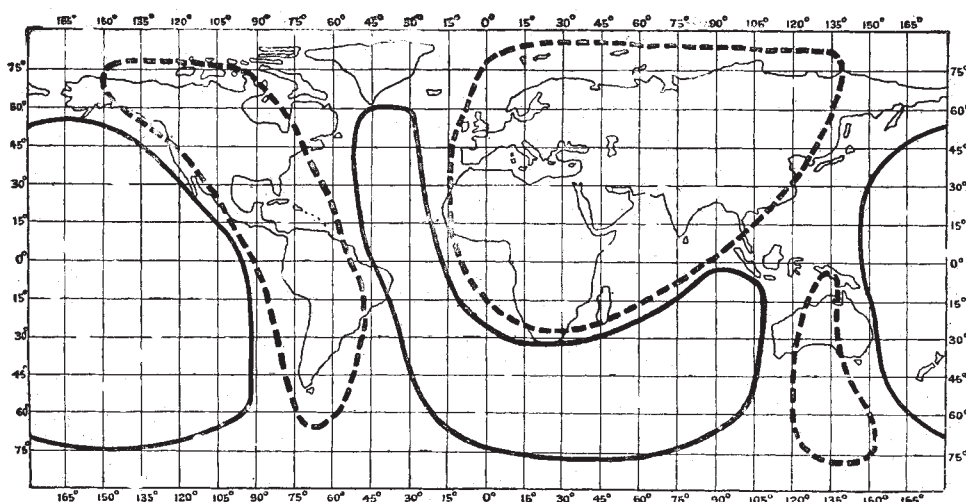
come from various members of the Wills family, no less a sum than 135,000*l.* having been promised toward its realisation by them. Of this amount, Mr. H. O. Wills has promised 100,000*l.*, Lord Winterstoke (formerly Sir W. H. Wills) 20,000*l.*, and Sir Frederick Wills 10,000*l.* More money is, however, still required to establish the University in a satisfactory manner; and it is to be hoped that other merchant princes of Bristol will follow the magnificent example which the Wills family has given them.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 30.—"Note on the Representation of the Earth's Surface by Means of Spherical Harmonics of the First Three Degrees." By Prof. A. E. H. Love, F.R.S.

In a previous paper the author had concluded from dynamical considerations that those elevations and depressions on the surface of the globe which correspond with continents and oceans should be capable of being represented, in respect of their main features, by means of spherical harmonics of the first, second, and third degrees. A rough spherical harmonic analysis of the



actual elevations and depressions yielded a rather imperfect representation of the surface, which nevertheless offered a general resemblance to the actual distribution of land and water. It had, however, certain definite defects. To alter the computed figure it is necessary to change appropriately the coefficients of the spherical harmonic expression by which it is proposed to represent the elevation of the surface above the mean level. In the present paper there is recorded the best of many sets of trial coefficients, and the result is shown on the accompanying chart. In this chart the fine continuous line is a rough outline of the actual land of the globe, drawn in such a way that all degrees of latitude or of longitude have the same value on the map; the heavy line is the zero line of the surface harmonic with the chosen coefficients; the dotted line is the contour line along which the computed elevation is equal to one-tenth of its maximum value.

"The Relation between the Crystalline Form and the Chemical Constitution of the Picryl Derivatives." By G. Jerusalem and Prof. W. J. Pope, F.R.S.

By a method which depends upon dividing up the space occupied by a crystalline substance into polyhedral cells, each of which is assumed to be the habitat of but one atom, Barlow and Pope have been able to determine the general relation which exists between crystalline form and chemical constitution. They conclude that the polyhedral cells, each of which represents the domain of one atom and which fit together without interstices to form the crystal structure, possess volumes which are approximately

proportional in magnitude to the lowest valencies exhibited by the elements which they respectively contain. The assemblages obtained by packing together the atomic domains mentioned are partitionable into identical units, each of which represents in composition, constitution, and configuration a chemical molecule of the substance concerned. The relation between the crystalline form and chemical constitution of a series of substances is conveniently illustrated by comparing the dimensions of polyhedra, of which the volumes are represented by the sum, W , of the valencies of the atoms composing the molecules, and of which the relative dimensions are the crystallographic axial ratios $a:b:c$. The dimensions referred to are termed the equivalence parameters $x:y:z$, and are calculated from the relations that $a:b:c=x:y:z$ and $xyz=W$.

In the present paper the above considerations are applied to a number of derivatives of picric acid and allied substances; it is shown that in this series one of the three equivalence parameters remains approximately constant, and has about the value of z in the equivalence parameters of crystalline benzene, namely, $x:y:z=3.101:3.480:2.780$. The direction in which the dimension z is measured in benzene is that in which columns formed by superposing triangularly arranged groups of three polyhedra, each occupied by a carbon atom, occur throughout the

assemblage representing crystallised benzene. It is concluded that the crystal structures of the picryl derivatives are derived from that of benzene by moving the columns of carbon domains apart and packing the substituting groups in between them in accordance with the method already described by Barlow and Pope.

"On the Hysteresis Loss and other Properties of Iron Alloys under very Small Magnetic Forces." By Prof. Ernest Wilson, V. H. Winson,

and G. F. O'Dell. Communicated by Sir William H. Preece, K.C.B., F.R.S.

The experiments were carried out on two alloys of iron, namely, "stalloy," of which the distinguishing feature is that it contains about 3 per cent. of silicon, and "lohys," which is a good sample of transformer plate. The principal object of the research is to find the magnetic properties of these materials under small magnetising forces, especially as regards hysteresis loss. Information is also given on the specific resistance and temperature coefficients of the materials.

For the magnetic tests the specimens are in the form of rings composed of stampings, and the ballistic galvanometer method has been employed.

Lord Rayleigh found by the magnetometer method that in the case of Swedish iron the permeability was nearly constant when the magnetic force (H) varied from 0.0004 to 0.04. In the present experiments the permeability also tends to become constant, the limiting values being 260 for stalloy and 222 for lohys. As regards the maximum value of the permeability, the results obtained have been compared with published figures for a very pure iron and a good sample of plate rolled from Swedish iron. For these materials the maximum permeabilities are respectively 5480 and 4450, and occur for values of the magnetic induction (B) of 9100 and 7000 respectively. For stalloy and lohys the maximum permeabilities are 4520 and 3280, and occur for values of B of 5000 and 5500 respectively.

As regards hysteresis loss, the following figures are

given in full, as they form the most important part of the paper. The loss for stalloy is somewhat lower than that for the pure iron specimen above alluded to, while that for lohys is slightly higher.

STALLOY			LOHYS		
B _{max.}	H _{max.}	Ergs per cycle per cub. c. centimetre	B _{max.}	H _{max.}	Ergs per cycle per cub. c. centimetre
0.1267	0.000474	—	0.70	0.00311	—
0.1918	0.000739	—	1.95	0.0087	—
0.674	0.00267	—	4.25	0.0181	0.000725
0.937	0.00357	0.0000111	8.99	0.0352	0.00645
1.870	0.00645	0.0000672	15.0	0.0523	0.0224
3.60	0.01286	0.000347	37.4	0.1042	0.152
8.25	0.0251	0.00384	84.1	0.1860	0.84
*13.02	0.0358	0.01153	286	0.404	8.80
38.0	0.080	0.0811	568	0.865	32.2
94.1	0.157	0.5680	965	0.697	85.0
171.0	0.245	1.686	1930	0.905	253
*269	0.312	4.810	3780	1.260	725
*620	0.420	21.65	6280	1.960	1620
2245	0.677	203.0	7970	2.740	2375
*6050	1.354	1030.0	11510	6.575	5060
8200	2.130	1688	13440	14.90	7050
9810	3.26	2335			
11500	5.71	3110			
13480	16.20	4530			

The stalloy specimen requires careful attention in order that a truly symmetrical hysteresis loop may be obtained, more especially for values of B between 200 and 8000. In an extreme case, after reducing the force H from about 63 to 0.712 without subjecting the specimen to a series of reversals of the magnetic force as it was reduced, a complete hysteresis loop was obtained. This loop is unsymmetrical in the sense that if the axis of H be so placed that the coercive forces are equal, the positive and negative values of the maximum induction B are not equal, but the positive and negative values of the residual magnetism are equal. The value of the permeability defined as the ratio of half the total change of magnetic induction to the maximum value of H is less than is the case when the loop is truly symmetrical. In the table the figures for loops which are not quite symmetrical are indicated by an asterisk.

The Steinmetz coefficients have also been investigated, the relation being ergs per cycle per cubic centimetre = αB^β . Both coefficients vary considerably. For stalloy the coefficients are very nearly constant between values of B of 600 and 11,000; over this range $\beta = 1.71$ and $\alpha = 0.000342$. For values of B from 0.937 to 8.25 the coefficient β is as high as 2.69. In the case of lohys, between values of 500 and 8000 for B, the values $\beta = 1.62$ and $\alpha = 0.00122$ approximately hold. In this case also the coefficient β rises to a high value when B is small.

Another matter investigated is the value of $\int H dB / H_0 B_{\max.}$, where H_0 is the coercive force. Dr. Sumpner has pointed out that this quantity is a linear function of $B_{\max.}$ over a large range. For stalloy and lohys the relation only holds apparently between values of B of 1000 and 9000.

The specific resistance and temperature coefficients were obtained in the case of each of the materials. The following figures are in each case the mean of the results of three independent experiments:—

	Mean specific resistance at 15° C. in 10^{-6} ohms per c. cm.	Mean temperature coefficients	
		0° to 50° C.	0° to 100° C.
Stalloy	49.63	0.000975	0.00103
Lohys	14.25	0.00424	0.00446

It will be seen that stalloy has a high specific resistance, which is important in connection with eddy current loss, as this is thereby reduced.

May 28.—“Effect of a Cross Wind on Rifled Projectiles.” By A. Mallock, F.R.S.

The effect of wind on rifled projectiles is important for practical reasons, especially in the case of small arms, but the object of the present note is not so much to determine

the actual effect of wind as to show that accurate experiments on the subject would afford valuable information concerning the flight of projectiles in still air.

It is easily shown that if the air resistance acts always in the direction of the resultant of the velocities of the wind and the projectile, the angle made by the resultant velocity with the line of aim remains constant throughout the range.

In order, however, that the resistance may act in the direction of the resultant velocity, the projectile must be symmetrical about that direction. This, in the case of any form except a sphere, means that the principal axis of the projectile must take the direction of the resultant velocity.

If this is assumed and we take v_0 as the initial velocity of the shot, w as the velocity of the wind (w/v_0 being small), and η as the coordinate of the shot perpendicular to the line of aim, we have at the time t

$$\eta = \frac{w}{v_0}(v_0 t - R) \text{ or } w \left(t - \frac{R}{v_0} \right) \quad (1)$$

This result was first given by Captain Younghusband, R.N., and would be correct if the axis of the projectile set itself in the direction of the resultant velocity from the very beginning.

At first, however, the axis makes an angle w/v_0 with the velocity resultant, and the resistance has therefore a horizontal component at right angles to that resultant, for the same reason that a small angle between the axis of the projectile and the tangent to the trajectory produces an upward force on the former.

The question, then, as to how far (1) may be looked on as giving a true value for the effect of the wind turns on the rate at which the projectile can set its axis in the direction of the velocity resultant.

It is shown, however, in a former paper,¹ that to produce a given angular velocity of the axis of a projectile the couple must vary as the fourth power of the linear dimension.

For a given inclination of the axis to the direction of motion the couple applied by action of the air will vary as the cube of the linear dimension; thus the angular velocity of the axis will be inversely as the linear dimension, or, in other words, the time for a given angle will be as the linear dimensions.

For a given inclination the lateral force will be as the square of the linear dimension, and the distance to which the lateral force will carry the projectile while turning through the angle w/v_0 will be proportional to the linear dimension.

Thus instead of the expression in (1) we should write

$$\eta = AL + w(t - R/v_0), \quad (2)$$

where L denotes the linear dimension and A some constant depending on the form, weight, and initial velocity of the projectile.

If careful experiments were made on wind deflection, the velocity of the wind being recorded at several positions along the range at the instant that each shot was fired, the value of A might be determined, and therefrom the angle which the axis of a projectile fired in still air makes with the tangent to the trajectory.

Physical Society, June 12.—Dr. Charles Chree, F.R.S., president, in the chair.—Experiments on a directive system of wireless telegraphy: E. Bellini and A. Tosi. The authors describe the results obtained in the course of their work upon a further development of their original directive system. In the earlier method previously described (*Electrical Engineering*, ii., p. 771, 1907, and iii., p. 348, 1908) it was not possible to say from which side of the receiving station the transmitted waves arrived, for though the radiation was practically confined to the plane of the aerial system, it was emitted equally in the opposite direction to that desired. In the new unilateral system the waves are sent in a single direction only, and the problem of getting rid of the backwardly extending radiation has thus been solved. The method adopted consists in superposing a bilateral directive system, as previously described, upon an ordinary or vertical antenna system. The system of unilateral directive wireless tele-

¹ “The Behaviour of Rifled Projectiles in Air,” Roy. Soc. Proc., vol. lxxix., p. 547.

graphy described in the present paper is of special interest owing to the facility with which it is possible to change over from one system to the other, thus, from the ordinary vertical antenna system to the bilateral directive or the unilateral directive, or *vice versa*. The aerial arrangements, moreover, remain exceedingly simple. When a message from a station of unknown position is expected, the vertical antenna or ordinary system would be employed; on once effecting reception, one can pass to the bilateral or unilateral directive system, and thus determine the direction and on which side the transmitting station lies, at the same time making oneself independent of other transmissions. In the same way, with the transmission, the vertical antenna would be employed for calling up an unknown station or for simultaneously sending to several stations; on getting a reply the operator can readily determine the position of the receiving station, with the aid of the unilateral system, and thenceforth will transmit solely in that direction.—The lateral vibration and deflection of clamped-directed bars: Dr. J. Morrow. This is an investigation of the problems which arise in connection with the lateral vibrations of clamped-directed bars. The term "directed" is used to describe the extremity of a bar which is constrained to maintain its original direction, but is free to take up any position of lateral deflection. These terminal conditions are mentioned in Rayleigh's "Sound," but are dismissed on the ground that the directed end cannot be realised experimentally. In the present paper, however, it is shown that the "directed" end is of great importance and of frequent occurrence in engineering practice, and, further, that by the aid of a simple device it can easily be investigated in the laboratory.—The resistance of a conductor of uniform thickness whose breadth suddenly changes, and on the shape of the stream-lines: Prof. C. H. Lees. A knowledge of the resistance of a conductor the section of which suddenly changes is of considerable practical importance, but mathematical difficulties have prevented an exact solution of the problem. The paper shows that the resistance between two transverse sections through points situated at considerable distance from the change of section on opposite sides of it is equal to the sum of the resistances of the portions of conductor between each of the two sections and the change of section, each considered as part of an infinite length, plus the resistance of a length of either conductor equal to its breadth multiplied by an expression given.—The inductance of two parallel wires: Dr. J. W. Nicholson. When direct and return currents flow in two wires of great length, and the alternation is not rapid, the effective self-induction per unit length of the system may be calculated readily by simple integration. If the wires have radii a , b , and permeabilities μ , ν , and if C be the distance between their axes,

$$L = 2 \log c^2/ab + \frac{1}{2}(\mu + \nu).$$

This formula is often of little practical use when the frequency of alternation is several thousands per second. Such frequencies are of constant use in practical work. For example, in the measurement of small inductances by Mr. Campbell's method, it is necessary to employ long leads in order to keep them at some considerable distance from the bridge and other circuits. The self-induction of these leads must be small, and a calculation of its value is very desirable. The general case presents very great mathematical difficulty, but the solutions given in the paper appear to include most cases of practical utility.—Homogeneous secondary radiation: Dr. Barkla and Mr. Sadler.—(1) Note on the amount of water in a cloud formed by expansion of moist air; (2) an elementary treatment of the motion of a charged particle in a combined electric and magnetic field: Prof. Morton.

DUBLIN.

Royal Irish Academy, May 11.—Dr. F. A. Tarleton, president, in the chair.—A synopsis of Irish algæ, fresh-water and marine: J. Adams. After an historical account of past investigations on Irish algæ, and the various attempts to divide the country into botanical districts, there follow complete lists of the genera and species, and their geographical distribution in each of the four provinces is briefly indicated. For facility of reference the genera

and species belonging to each of the main groups of algæ are arranged in alphabetical order. In all, 2224 species are included, 1379 species being fresh-water and 845 species marine. A summary of the total species recorded for each province is given, followed by a brief description of the local distribution of the rarer or more interesting species. At the end is a bibliography in which all known sources of information on the distribution of Irish algæ are indicated.

May 25.—Dr. F. A. Tarleton, president, in the chair.—Some unpublished work of the late Prof. Charles J. Joly, F.R.S., on geometry, part i.: Rev. W. R. Westropp Roberts. The author discusses curves, both plain and twisted, by expressing the coordinates of such curves in terms of a parameter, and deduces from this point of view the nature of their singularities.—Some general principles of the theory of dimensions: E. E. Fournier d'Albe. The author discusses the methods of discovering relations between physical quantities by means of their dimensions. He shows that when the quantity investigated is purely mechanical, and expressible in terms of length, mass, and time, it can depend upon not more than three independent variables, which are also purely mechanical quantities. When the number of fundamental units is increased, as by adding angle, temperature, or electric quantity, the number of independent physical variables is increased in proportion. The attempts to account mechanically for forces acting at a distance by means of dimensional formulæ are criticised.

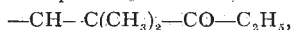
PARIS.

Academy of Sciences, June 22.—M. H. Becquerel in the chair.—Study of the phenomena shown by concave wings in the stationary, floating, and hovering flight of birds: Marcel Deprez. A calculation of the horizontal and vertical components of the forces resulting from the action of air in motion on the surfaces of wings, supposed curved. The formula arrived at contains no other experimental condition than the mass of unit volume of air, thus dispensing with the empirical coefficients commonly employed.—M. Gaillot was elected a correspondant in the section of astronomy, in the place of the late M. Trepied.—The analysis of polymorphic curves: Emile Borel.—The orientation of an anisotropic ellipsoid in a uniform field: Georges Meslin.—The nature of charges of positive electricity and the existence of positive electrons: Jean Becquerel. The recent work by the author on the magneto-optic phenomena of the rare earths over a wide scale of temperature leads to the view that positive electrons exist; Lilienfeld has also obtained phenomena which he attributes to positive electrons, but these results have been negated by Bestelmeyer and Marsh. In the present paper an account is given of experiments with a modified form of Crookes's tube. The results confirm the hypothesis of the existence of positive electrons.—The photographic registration of sound vibrations: Georges and Gustave Laudet. These photographs, which were obtained by purely mechanical means and without the aid of a microphone, are distinguished by the clearness of the line produced. Reproductions of the vowels and the sibilants s and z and of the word Laudet are given. No details are given of the method employed.—The relation between the biochemical effects of radiations and the quantity absorbed: H. Guilleminot. In studying the biochemical effects of the X-rays, it is more important to make quantitative measurements on the energy absorbed in the material than to measure the energy of the incident bundle. Fluoroscopic measurements of the incident rays show great divergences between the biochemical effects of the X-rays and the radium rays; these discrepancies disappear when the amount of energy really absorbed in the two cases is studied.—The heat of neutralisation of acetic and benzoic acids by aniline in benzene solution: Leo Vignon and M. Evieux. Aniline does not react to form salts with acetic and benzoic acids in benzene solutions. Aniline benzoate and acetate are destroyed by solution in benzene.—A new method of separation of silica and tungstic anhydride: Ed. Defacqz. At a red heat silica is not reduced by hydrogen, whereas tungstic anhydride is readily reduced to lower oxides under the same conditions. The latter are readily removed by heating in a current of chlorine, forming

volatile chlorides and oxychlorides, the silica remaining unchanged in the boat.—A new automatic principle applied to the carburettor: A. **Lauret**. A description of a new form of carburettor for internal combustion engines possessing the advantages of being free from moving parts, strictly automatic in its action, and freedom from liability to derangement.—The constitution of some derivatives of diphenylmethane and the preparation of some orthodiamines of this series: H. **Duval**.—The α -dialkyl- β -ketonic alcohols and their transposition by dehydration: E. E. **Blaise** and I. **Herman**. The course of the transposition under the influence of alkalis of the ketone



is shown to consist probably in a dehydration to



followed by a migration of a methyl group resulting in the ketone



—Study of the molecular concentration of the liquids of the organism in the pathological state: Adolphe **Javal**. The cryoscopic constant of liquids extracted from pathological growths is generally greater than the normal figure -0.56 , and it is shown that this cannot be accounted for by the presence of an abnormal excess of sodium chloride. The amount of nitrogenous products in these pathological fluids is above the normal, but is insufficient to account for the observed hypertonicity.—A chemical character differentiating the orthoses and the microclines: Ph. **Earbier**. The orthoses uniformly contain small quantities either of lithium or rubidium, frequently both; these elements are absent from the microclines. The exact method of separating these alkalis is given in detail.—*Synalpheion giardi*, an entoniscian parasite of *Synalpheus longicarpus*: H. **Coutière**.—The comparative anatomy and histology of the Blochmann glands in the Tectibranchs: Rémy **Perrier** and Henri **Fischer**.—Chromatic reactions and classification of the leucocytic granulations of the invertebrates: M. **Kolmann**.—Vascular elasticity and its variations: Gabriel **Arthaud**.—The acetyl derivative of atoxyl in sleeping sickness: Paul **Salmon**. The acetyl derivative of atoxyl has been in the form of sodium salt (sodium acetyl-para-amido-phenylarsenate) in experiments on the treatment of sleeping sickness. It possesses the advantages of being perfectly soluble, sterilisable at 100°C . without decomposition, and less toxic than atoxyl itself. Experiments on rats, guinea-pigs, and apes infected with *Trypanosoma gambiense* demonstrate that acetyl-atoxyl may be administered in doses four times as great as atoxyl, causing the disappearance of the trypanosome from the blood of the animals.—The geological constitution of the massif of Beni Snassen, Morocco: Louis **Gentil**.—The eolian origin of the finely divided minerals found on the sea floor: M. **Thoulet**. An account of a quantitative study of atmospheric dust collected on the tower of Nancy Cathedral, 75 metres above the ground.—Two new sheets of the industrial map of zoology of the coasts of France: M. **Joubin**.—The torrential origin of ruin-shaped limestone rocks: E. A. **Martel**.—The radio-activity of the waters of Ax (Ariège), demonstrated by photography: F. **Garrigou**.—Rain and the state of water-courses: Paul **Garrigou-Lagrange**.—The ablation of the glacier at Chamonix during fifteen years and during fifty years: J. **Vallot**.—New magnetic determinations in the western basin of the Mediterranean: Charles **Nordmann**.

NEW SOUTH WALES.

Linnean Society, March 25.—Mr. A. H. Lucas, president, in the chair.—Notes on the native flora of New South Wales, part vi., Deepwater to Torrington and Emmaville: R. H. **Cambage**. Although the locality the flora of which is described lies to the west of the Great Dividing Range, a large percentage of the plants noticed occur also in the Sydney district. The similarity of the two floras is attributable to somewhat similar geological formations, for while the Sydney rocks are sandstone, the acid granites of Torrington contain quite 75 per cent. of silica, and the soil derived therefrom approximates to that of a sandstone area. Reference is made to the occurrence of both inland and coastal plants, an association which is intelligible on the

ground that the effect of higher altitude is counterbalanced by that of a more northerly latitude.—Note on the breeding habits of the red-bellied newt (*Molge pyrrhogastra*, Boie): E. R. **Waite**.

CAPE TOWN.

Royal Society of South Africa, April 6.—Mr. S. S. Hough, F.R.S., president, in the chair.—Transvaal sea-level temperatures: R. T. A. **Innes**. The object of the paper was to find what reductions applied to temperature readings in the Transvaal would reduce them to sea-level temperatures. For this purpose, a curve was plotted with the temperature entered horizontally and the altitudes vertically. This was assumed to be a parabola, and the correction was calculated on this assumption. A comparison with Buchan's maps in Bartholomew's Meteorological Atlas showed great differences. These the writer attributed to the fact that Buchan had no South African data on which to base his correction.—The geology and mineralogy of Albany: Prof. **Young**. The author described the evidence he had of volcanic action having occurred in the Albany district along a line of crustal weakness running east and west some miles to the south of Grahamstown. He described some investigations he had carried out on some of the rocks and minerals found in the neighbourhood of this volcanic line. The evidence goes to show that the district is mineralised with gold and other rare metals, and that a mineral grease or oil occurs in association with the rare metals. He also suggested several chemical reasons to account for the failure of most South African assayers to detect these metals, while the European assayers have found them in several hundreds of samples from Albany during the last two years.

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